Lecture 16
March 10, 2005

Know:

1. The definitions of electric current
2. The definition of resistance
3. Ohm's Law relating current, potential difference, and resistance to each other
4. The definition of electric resistance and electrical power
5. The difference between direct current (d.c.) and alternating current (a.c)

Understand:

1. How current flow in a complete circuit
2. How to use Ohm's Law to calculate current, potential difference or resistance in a circuit
3. How to reduce series or parallel combinations of resistance to a single resistance
4. How to calculate the power supplied by or dissipated by a circuit element

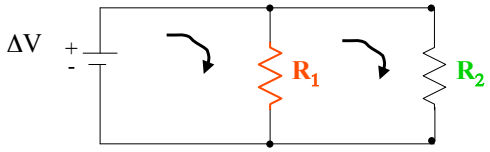
Resistance

The resistance (in ohms) of a conductor is how much potential difference (voltage) you need to apply so that 1 amp of current will flow through the conductor

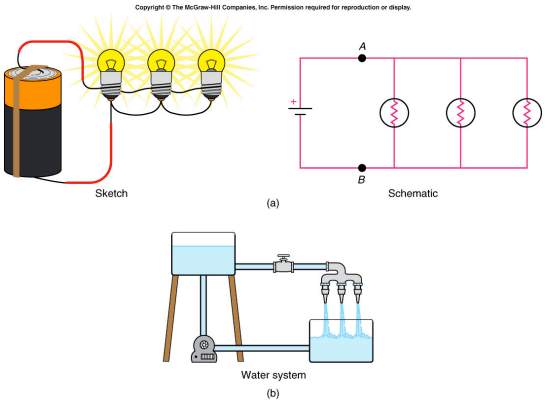
$\Delta V = IR$ **"Ohm's Law"**

Parallel Circuits

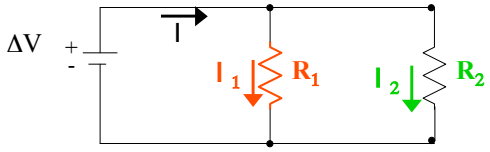
- If you hook up two resistors simultaneously to the same battery so that there is **more than one loop** in the circuit they are said to be in **parallel**.
- Each resistor is subject to the same potential difference ΔV



Parallel Circuit Water Analogy



Resistors in Parallel

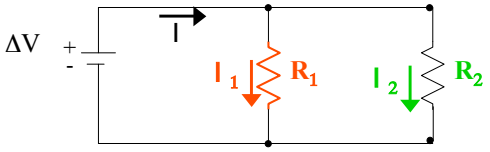


- When all elements in a circuit have **same potential DV** then they might different current going through them since the current depends on the resistance value

Ohm's Law applied to R_1 $\quad \Delta V = I_1 R_1 \Rightarrow I_1 = \dfrac{\Delta V}{R_1}$

Ohm's Law applied to R_2 $\quad \Delta V = I_2 R_2 \Rightarrow I_2 = \dfrac{\Delta V}{R_2}$

Resistors in Parallel (II)



- For resistors in parallel we can calculate the total resistance (R_T)of the circuit as:

$$\frac{1}{R_T} = \frac{1}{R_{parallel}} = \frac{1}{R_1} + \frac{1}{R_2}$$

- Once the total resistance is known, the current is:

$I = \Delta V / R_T$ **Note: $I = I_1 + I_2$**

Two light bulbs are installed in two sockets, the sockets are connected I n series, and power is then applied to the combination so that both bulbs light. If one of the bulbs is then removed from its socket, the other one will

A. get brighter.
B. remain equally bright.
C. get dimmer.
D. go out.

A 40 W bulb and a 60 W bulb are connected in series with a 120 V power source. Which of the following is true for this arrangement?

A. The 40 W bulb is brighter than the 60 W bulb.
B. The 60 W bulb is brighter than the 40 W bulb.
C. The 60 W bulb is brighter than it would be if the 40 W bulb were replaced by a wire.
D. The 40 W bulb is brighter than it would be if the 60 W bulb were replaced by a wire.

An ohm is equal to which of these?

A. a volt B. a coulomb per second
C. a volt per ampere D. an ampere per second

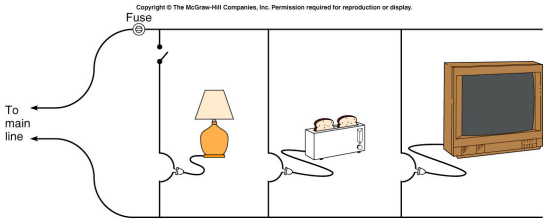
A 12 ohm resistor and a 24 ohm resistor are connected in parallel across a 6.0 V battery. The correct statement from the following is

A. the current is the same in each resistor.
B. the power dissipated is the same in each resistor.
C. the voltage difference between the ends of each resistor is the same.
D. the larger current is in the larger resistor.

A 12 ohm resistor and a 24 ohm resistor are connected in series with a 6.0 V battery. The correct statement is

A. the voltage difference between the ends of each resistor is the same.
B. the current in each resistor is the same.
C. the power dissipated in each resistor is the same.
D. the smaller resistor carries the larger current.

Household Circuit



- Every appliance in the house is connected in parallel.

See light bulb demo

Electric Power

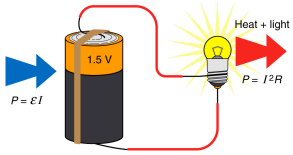
- Since Voltage is Potential energy per unit charge, multiplying potential by charge yields energy. Therefore multiplying Voltage by charge per unit time or current we obtain power.
- Therefore we can calculate power released by current flowing through a circuit is the potential difference times the current.

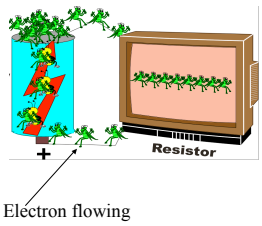
$$P = I\Delta V$$

- This power may appear as heat, light (eg. Light bulb), TV pictures or video game action.

Electric Power In Every Day Life

- This power may appear as heat, light (eg. Light bulb), TV pictures or video game action.





Electric Power (II)

- Using Ohm's Law

$$\Delta V = IR \qquad I = \frac{\Delta V}{R}$$

- We can rewrite the equation for power:

$$P = I\Delta V = I^2 R$$

- Or:

$$P = I\Delta V = \frac{(\Delta V)^2}{R}$$